The invention claimed is:

1. A method for refining the microstructure in titanium alloys in a single thermo-mechanical processing (TMP) step, comprising the step of subjecting a boron-containing titanium alloy to a TMP step to provide a titanium alloy having a fine-grained, equiaxed microstructure after a single TMP step.

2. The method of claim 1 wherein the boron-containing titanium alloy comprises an alloy selected from the group consisting of Ti-5Al-2.5Sn, Ti-6Al-4V, Ti-5.5Al-1Fe, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-8Al-Mo-1V, Ti-10V-2Fe-Mo, Ti-4.5Fe-6.8Mo-1.5Al, Ti-5Al-1Fe, Ti-8Mn, and CP Ti.

3. The method of claim 2 wherein the boron-containing titanium alloy comprises Ti-6Al-4V.

4. The method of claim 1 wherein the titanium alloy comprises from 0.01% to 18.4% boron by weight.

5. The method of claim 5 wherein the titanium alloy comprises from 0.5% to 1.6% boron by weight.

6. The method of claim 1 comprising the additional step of subjecting the titanium alloy having a fine-grained, equiaxed microstructure to one or more additional TMP steps to produce a desired shape.

7. A method for refining the microstructure in titanium alloys in a single TMP step comprising the steps of:

   a) adding boron to a titanium alloy to form a boron-containing titanium alloy; and

   b) subjecting the boron-containing titanium alloy to a TMP step; wherein a fine-grained, equiaxed microstructure in the titanium alloy is achieved after a single thermo-mechanical processing step.

8. The method of claim 7 wherein the boron is added to the titanium alloy in a liquid state, wherein the boron is dissolved in the liquid titanium alloy.

9. The method of claim 7 wherein the boron is added to the titanium alloy through intermixing of a boron-containing powder and a titanium-containing powder.

10. The method of claim 7 wherein the boron is selected from the group consisting of elemental boron, TiB_2, or a boron-containing alloy.

11. The method of claim 7 wherein the boron is added to the titanium alloy in the range from 0.01% to 18.4% by weight.

12. The method of claim 11 wherein the boron is added to the titanium alloy in the range from 0.5% to 1.6% by weight.

13. The method of claim 7 wherein the boron-containing titanium alloy comprises an alloy selected from the group consisting of Ti-5Al-2.5Sn, Ti-6Al-4V, Ti-5.5Al-1Fe, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-8Al-Mo-1V, Ti-10V-2Fe-Mo, Ti-4.5Fe-6.8Mo-1.5Al, Ti-5Al-1Fe, Ti-8Mn, and CP Ti.

14. The method of claim 13 wherein the boron-containing titanium alloy comprises Ti-6Al-4V.

15. A method for achieving beta-phase superplasticity in titanium alloys, the method comprising the step of deforming a boron-containing titanium alloy under beta-phase strain rates and temperatures that correlate with the titanium alloy and boron content.

16. The method of claim 15 wherein the boron-containing titanium alloy comprises from 0.01% to 18.4% boron by weight.

17. The method of claim 16 wherein the boron-containing titanium alloy comprises from 1.6% to 2.9% boron by weight.

18. A method for achieving beta-phase superplasticity in titanium alloys, the method comprising the steps of

a) adding boron to a titanium alloy to form a boron-containing titanium alloy;

b) determining beta-phase strain rates and temperatures for the boron containing titanium alloy; and

c) deforming a boron-containing titanium alloy under beta-phase strain rates and temperatures determined in step a.

19. The method of claim 18 wherein the boron is added to the titanium alloy in a liquid state, wherein the boron is dissolved in the liquid titanium alloy.

20. The method of claim 18 wherein the boron is added to the titanium alloy through intermixing of a boron-containing powder and a titanium-containing powder.

21. The method of claim 18 wherein the boron is selected from the group consisting of elemental boron, TiB_2, or a boron-containing alloy.

22. The method of claim 18 wherein the boron is added to the titanium alloy in the range from 0.01% to 18.4% by weight.

23. The method of claim 33 wherein the boron is added to the titanium alloy in the range from 0.5% to 1.6% by weight.

24. The method of claim 18 wherein the boron-containing titanium alloy comprises an alloy selected from the group consisting of Ti-5Al-2.5Sn, Ti-6Al-4V, Ti-5.5Al-1Fe, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-8Al-Mo-1V, Ti-10V-2Fe-Mo, Ti-4.5Fe-6.8Mo-1.5Al, Ti-5Al-1Fe, Ti-8Mn, and CP Ti.

25. The method of claim 24 wherein the boron-containing titanium alloy comprises Ti-6Al-4V.

26. A part formed by the method of claim 15 or 18.